

Using Recirculating Well Technology to Control the Migration of Volatile Organic Compound Contaminated Groundwater in Brazil

Susanne Loebmann, Beatriz Gil, Regiane Costa, ERM, São Paulo, SP, Brazil; Derek Ross, ERM, Malvern, PA, USA.

Project activities included

- ✓ Preliminary services, including setting up the construction site
- ✓ Installation of six pairs of recirculation wells, with six wells in the upper layer of the overburden aquifer and six wells in the lower layer
- ✓ Installation of two monitoring wells
- ✓ Construction of the Recirculating Well Technology (RWT) remediation system, and
- ✓ Start-up

RWT system includes recirculation wells installed at the northwest boundary of the site to treat the following compounds of concern: cis-1,2 dichloroethene (DCE), vinyl chloride (VC) and toluene.

The RWT combines in situ air stripping, air sparging, soil vapor extraction (SVE) and enhanced aerobic bioremediation / oxidation technologies in association with subsurface groundwater recirculation.

- ➔ VOC values in groundwater have decreased significantly with the concentrations of 1,2 – DCE, vinyl chloride and toluene below quantification limits or reference values in the majority of the wells influenced by the system.
- ➔ 72 kg of VOC have been removed as vapor by the RWT system.

Site Background

A pharmaceutical manufacturing facility site located about 30 km from downtown São Paulo, SP, Brazil, has Volatile Organic Compound (VOC) impacted groundwater migrating off-site. Remediation activities are designed to control the migration of VOCs to one of the two rivers bordering the site.

Results from Previous Investigations

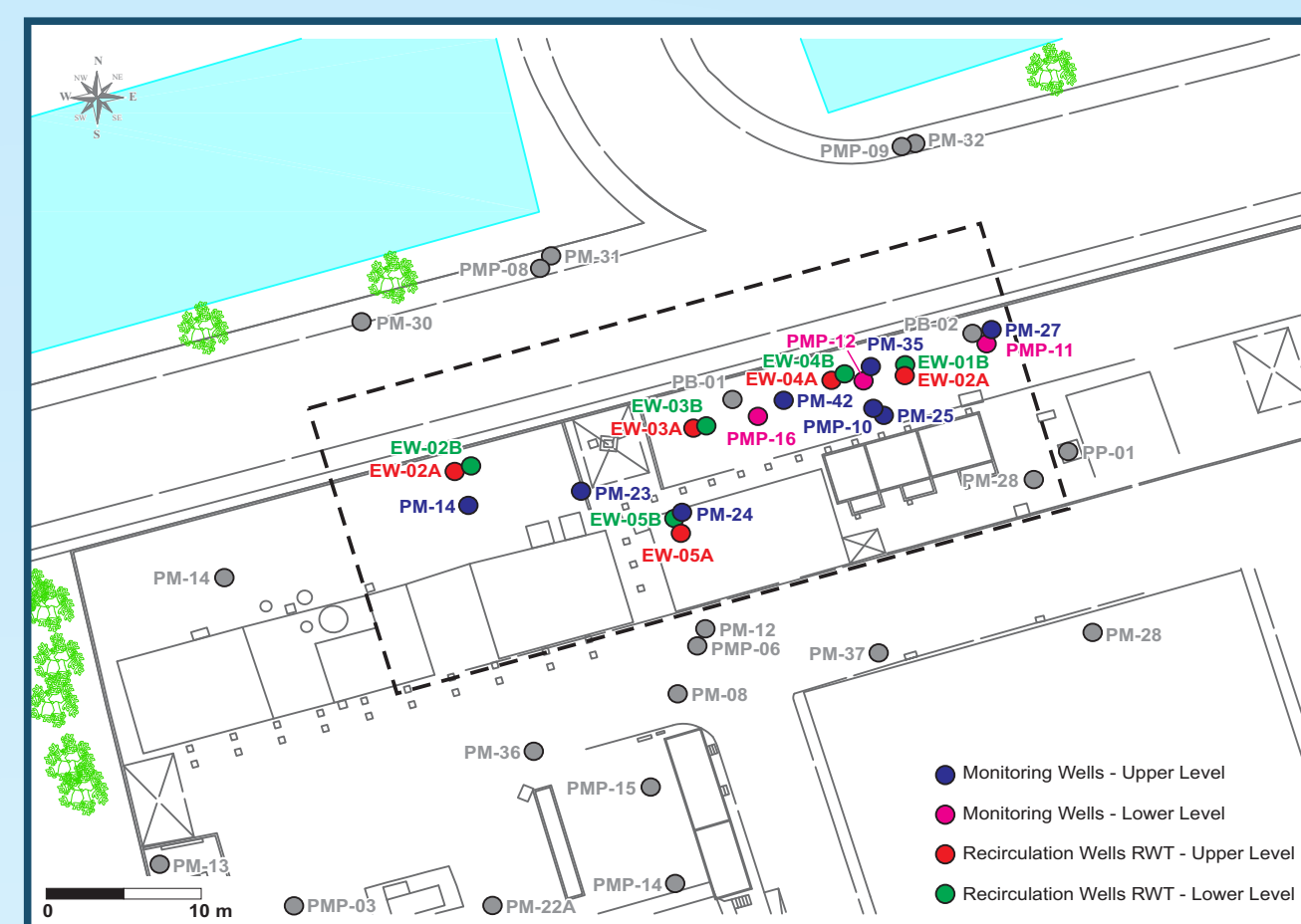
Groundwater, through the existing monitoring wells, has been analyzed since 2005. The major Compounds of Concern (COC) are trichloroethylene (TCE), cis-trans-1,2-dichloroethylene (1,2-DCE), 1,1-dichloroethylene (1,1-DCE), vinyl chloride (VC), toluene, ketones (methyl isobutyl ketone and acetone), methanol and total petroleum hydrocarbons (TPH). Within the Recirculating Well Technology (RWT) system zone of influence, the primary COC are 1,2-DCE, VC and toluene.

Objective

The RWT System was installed on the northwest boundary of the site to prevent the migration of the dissolved phase plume toward the River.

Design System

The RWT System is comprised of 12 wells. Six (6) wells were installed in the upper layer of the overburden aquifer and six (6) in the lower layer. Extracted vapors are sent to a vapor/water separation tank and then to an off-gas treatment system, where contaminant concentrations are abated before discharge into the atmosphere.



Performance

The performance of the RWT system was assessed through the collection of groundwater quality data. Air emissions were also monitored to evaluate the efficiency of the off-gas treatment system, to calculate the mass of VOCs removed by the RWT system and to check the efficiency of the vapor treatment system.

System monitoring activities were conducted weekly in order to verify the integrity of the lines, system components and operational parameters.

Results

1) Within the zone of influence of the RWT system, changes in the groundwater contours were observed. Different from the other areas, where the groundwater levels increased between December 2012 and May 2013, the groundwater levels measured in most wells influenced by the RWT system decreased, resulting in an active capture zone.

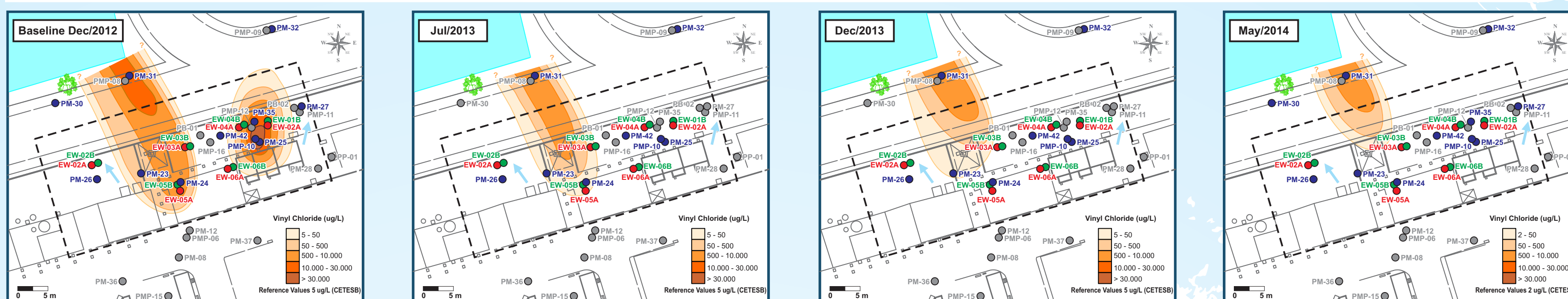


2) The most significant reductions were observed in the eastern area of the groundwater plume (PMP-10 area). The concentrations in PMP-10 decreased gradually for 1,2-DCE (16,272ug/L to <1ug/L), VC (40,400 ug/L to 1.8 ug/L) and toluene (39,400 ug/L to <1 ug/L) and in May 2014, concentrations in PMP-10 were all below CETESB reference values.

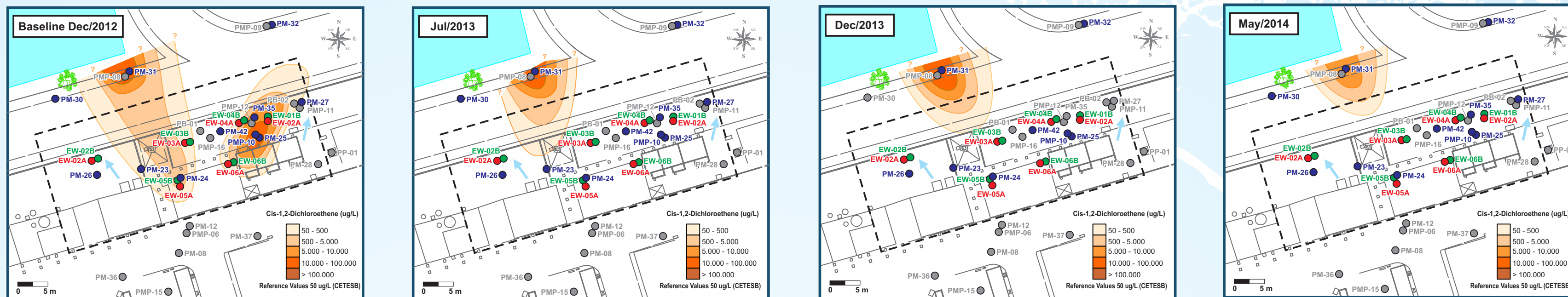


- ➔ Volatile Organic Compound (VOC) were detected in the overburden aquifer with concentrations above the applicable environmental groundwater standards since 2005.

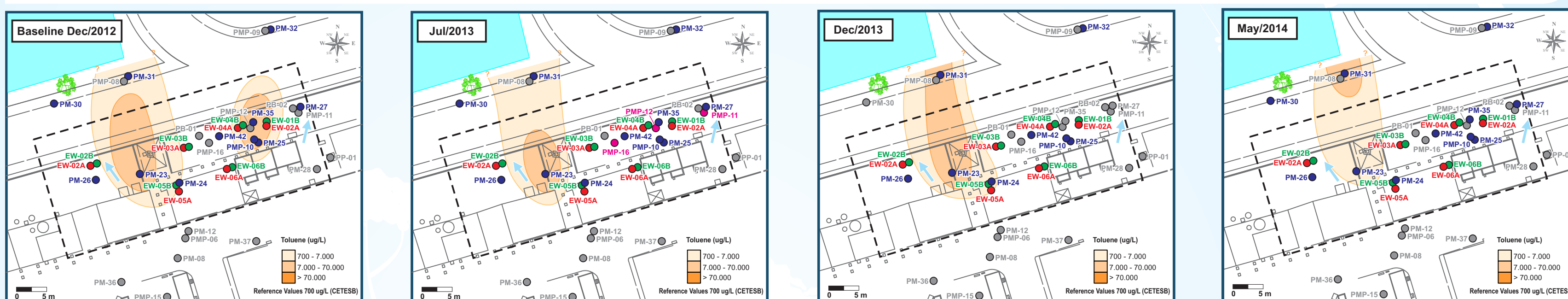
Historical Concentration of Vinyl Chloride - Upper Level



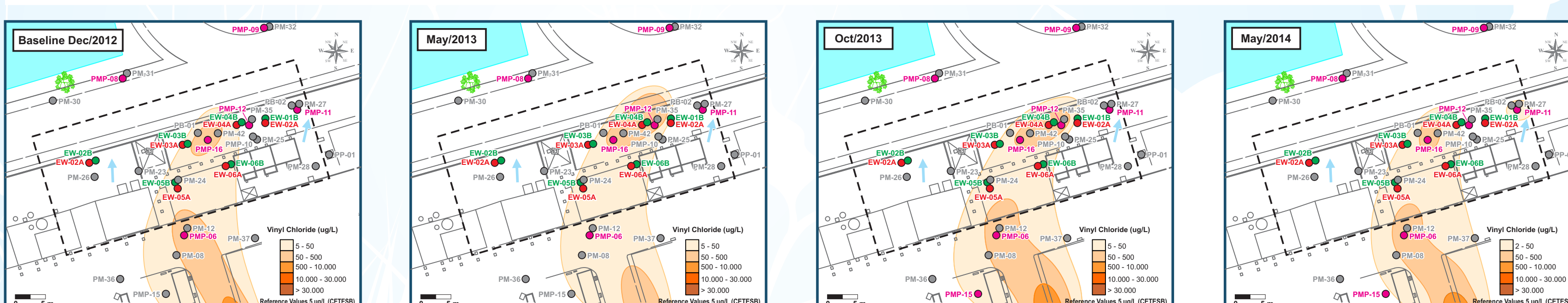
Historical Concentration of Cis-1,2-Dichloroethene - Upper Level



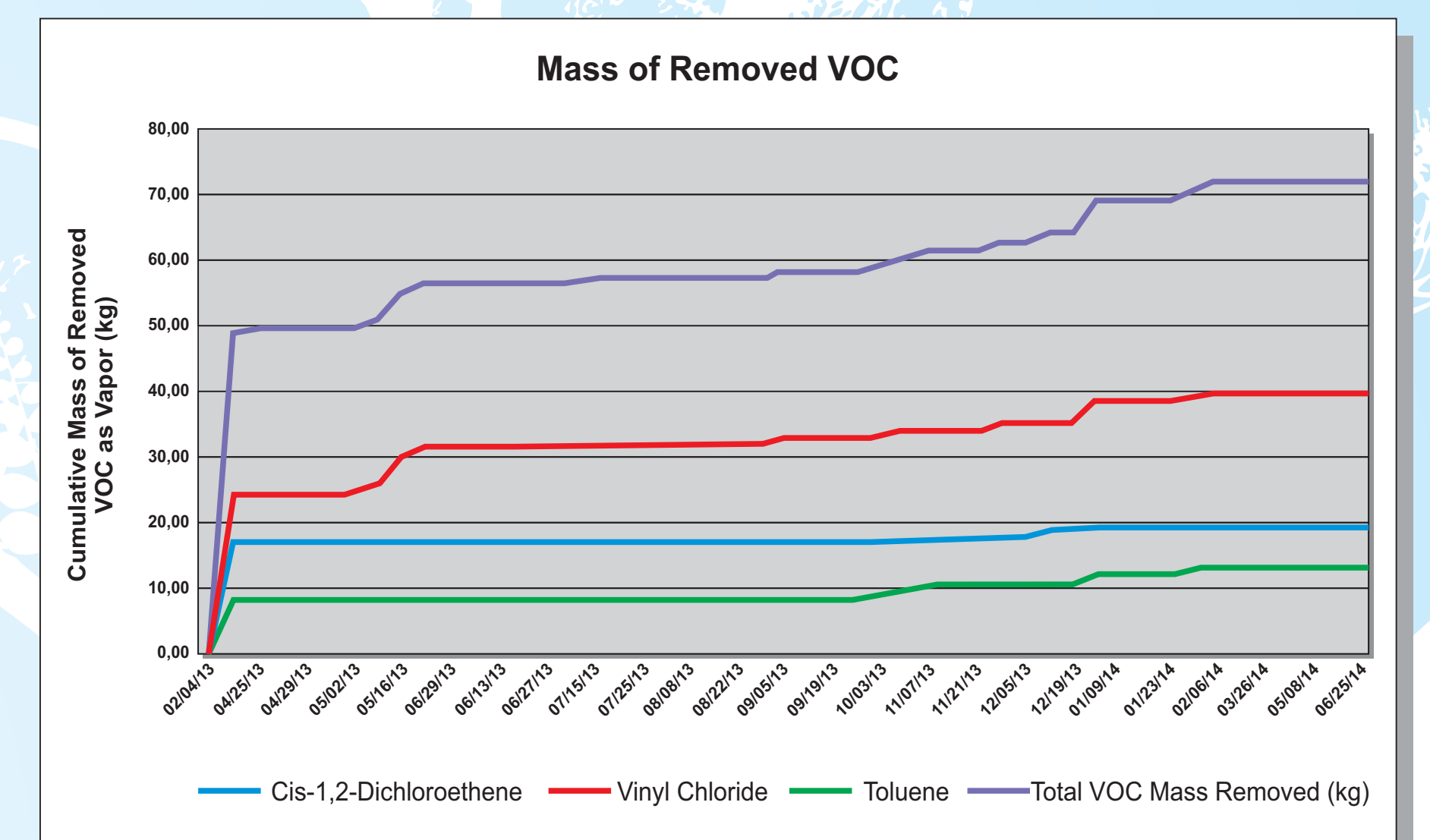
Historical Concentration of Toluene - Upper Level



Historical Concentration of Vinyl Chloride - Lower Level



- 3) 72 kg of VOC have been removed in the vapor phase of the RWT system.



With the decrease in concentrations in the eastern area, the air injection and extraction was biased (higher injection and extraction flow rates) to the wells in the western area of the plume area to more effectively treat this area. The result is evidenced by the decrease in toluene concentrations, mainly in PM-23 (45,730ug/L to 1,240ug/L).

VC breakthrough occurred in the off-gas treatment system in March, 2013. This issue was resolved by replacing the second carbon unit with a Purafil unit. No breakthrough has occurred since the Purafil unit was installed. Carbon was replaced one more time in February, 2014.